INTER-OBSERVER AND INTRA-OBSERVER RELIABILITY OF ROCKWOOD CLASSIFICATION AMONG ORTHOPEDIC RESIDENTS

ROCKWOOD SINIFLAMASININ ORTOPEDİ ASİSTANLARINDA GÖZLEMCİLER ARASI VE GÖZLEMCİ İÇİ GÜVENİLİRLİĞİ

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Öz

Amaç: Bu çalışmada, akromiyoklaviküler eklem (AKE) yaralanmalarında kullanılan Rockwood sınıflamasının ortopedi asistanlarında gözlemci içi ve gözlemciler arası güvenilirliğinin araştırılması amaçlandı. Gereç ve Yöntem: Akromiyoklaviküler eklem yaralanmasını gösteren omuz ön-arka grafilerinin bulunduğu 37 slaytlık bir Microsoft® Power Point (PPT) sunumu hazırlandı. Toplam 15 ortopedi asistanından PPT sunusundaki yaralanmaları Rockwood sınıflamasına göre sınıflandırmaları istendi. Üç ay sonra slaytların yerleri değiştirilerek değerlendirme tekrar yapıldı. Gözlemci içi ve gözlemciler arası uyumu değerlendirmek için intraclass correlation coefficient(ICC) değerleri hesaplandı. Bulgular: Tüm araştırmacılar göz önüne alındığında, gözlemci içi uyum için ICC değeri 0.732 (0.476-1) , gözlemciler arası uyum için ICC değeri 0.690 (0.654-0.739) olarak bulundu. Asistan hekimlerin özellikle tip 2-3 ve tip 3-5 ayırımı yapmakta zorlandıkları görüldü. Tartışma: Çalışmamızın sonuçları; her ne kadar asistan hekimler için Rockwood sınıflamasının gözlemciler içi ve arası güvenilirliğinin kabul edilebilir düzeyde olduğunu göstermekteyse de tip 2 ile tip 3 ve tip 3 ile tip 5 yaralanmaların ayrımının yapılmasının zor olduğu dikkat çekmektedir.

Anahtar Kelimeler

Rockwood Sınıflaması; Asistan; Gözlemciler Arası; Gözlemci İçi

Abstract

Aim: The purpose of this study was to evaluate intra and inter-observer reliability of the Rockwood classification system, which is used to assess acromioclavicular (AC) joint injuries, in terms of orthopedics residents' evaluation. Material and Method: A Microsoft® Power Point (PPT) presentation with 37 slides including shoulder anterior-posterior radiographs displaying acromioclavicular joint injuries was prepared. A total of 15 orthopedic residents were asked to classify the injuries according to the Rockwood classification system. The order of the slides was changed and the assessment was again carried out three months later by the same reviewers. In order to assess intra- and inter-observer agreement levels, intra-class correlation coefficient (ICC) values were calculated. Results: When considering the results of all the participants, the kappa value for intra-observer and kappa value for inter-observer reliability were found to be 0.732 (0.476-1) and 0.690 (0.654-0.739), respectively. Analysis indicated that residents had difficulty in differentiating type 2-3 and type 3-5 injuries. Discussion: Although our studies' finding was that there was an acceptable intra- and inter-observer reliability for Rockwood classification among orthopedics residents, it was evident that differentiating type 2 and type 3 injuries and differentiating type 3 and 5 injuries was difficult.

Keywords

Rockwood Classification; Resident; Inter-Observer; Intra-Observer

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Introduction

Acromioclavicular (AC) joint injuries constitute approximately 9% of shoulder girdle injuries. AC injuries are frequently seen in males and young athletes and most commonly occur as a result of falling on the shoulder [1]. The force that occurs as a result of falling on the shoulder directs the acromion to the medial and inferior. Based on the force intensity, a stress occurs in the acromioclavicular ligament, then a rupture in the coracoclavicular ligaments, and finally separation of the deltoid and trapezius muscles can occur. This pathologic characteristic of acromioclavicular joint dislocation was first described by Cadenat. Tossy et al. have classified these injuries as types 1, 2, and 3. [2]. Because this classification system considers the displacement only in the frontal plane, it does not include all of the possible injuries. Rockwood et al. has expanded the classification by adding types 4, 5, and 6 [3]. The Rockwood classification system is being used in both diagnosing AC joint injuries and in planning the treatment, whether conservative or surgical. Type 1 and type 2 injuries are undisplaced injuries and can be conservatively treated, without surgery. The treatment of type 3 injuries with superior displacement of the clavicle as a result of acromioclavicular and coracoclavicular ligament rupture is controversial [4-8]. Since type 5 injuries show advanced displacement, a surgical treatment is suggested for such injuries [3, 9]. It is difficult to differentiate type 3 and type 5 injuries by the evaluation of AP radiographies. Type 3 injuries are characterized as 100% displacement of the coracoclavicular space; a displacement between 100-300% is classified as a type 5 injury. The clavicle is displaced posteriorly into the trapezius muscle in type 4 injuries. The diagnosis of these injuries is made easier by adding axial radiography or computerized tomography [10].

There are a few studies of Rockwood classification's inter- and intra-observer reliability in the literature. In light of these studies, the dislocation level of the acromioclavicular joint is questionable and may not be useful for surgeons to choose the appropriate treatment modality [11-14]. These injuries are generally assessed by the residents who specialize in orthopedics in the emergency departments. Therefore, we aimed to evaluate the intra- and inter-observer reliability of the Rockwood classification among orthopedics residents. By considering that the reliability of this classification system increases with experience, our hypothesis was that the intra- and inter- observer reliability of this classification would be low among residents.

Material and Method

The patients admitted to the emergency department with the diagnosis of AC joint injury between January 2013 and December 2014 were retrospectively evaluated from the hospital's digital database. The study was approved by the local ethics committee. Inclusion criteria were: patients with both coracoclavicular spaces visible on the same radiograph, patients with acute injury, patients with unilateral injury, and patients with closed clavicular physis. The radiographies of the 51 patients with AC joint injury were assessed. 12 patients whose shoulder joints were not seen in the same radiography and 2 patients with chronic AC joint dislocation were excluded from the study. 37 patients whose distal clavicular physis had been closed and with unilateral injury were included in the study. The anterior-posterior shoulder and postero-anterior lung radiographs were taken from the hospital's digital system and were then recorded in the Joint Photographic Experts Group (JPEG) format. A Microsoft® Power Point (PPT) presentation was made with 37 slides, each of which had a single patient's radiographs, selected by a non-participant of the study. A total of 15 orthopedic residents participated in the study. Each resident was asked to examine the slide and to classify the injuries with the Rockwood classification system. Explanations and figures related to the classification system were quoted from a well-known orthopedic trauma book and were distributed to the study participants. Each participant individually carried out the assessment. After three months, the order of the slides was changed. The new order of the slides was recorded to assess the intra-observer reliability. The participants were then asked to re-evaluate the radiographs; they were given two weeks to complete the assessment. The second assessment's results were organized for the calculation of intra-observer reliability. Residents were evaluated by number of working years and kappa values were statistically compared.

Statistical analysis was performed by calculating the coefficient kappa value using SPSS 17 statistical software for inter- and intra-observer reliability. The inter-observer reliability kappa value was calculated by comparing the first classification between participants. Intra-observer reliability kappa value was calculated by comparing the first and the second classification for each observer. The kappa value coefficient was interpreted according to the guidelines proposed by Landis and Koch: less than 0.00 poor, 0.00-0.20 slight, 0.21-0.40 fair, 0.41-0.60 moderate, 0.61-0.80 substantial agreement, and 0.81-1.00 almost perfect agreement [15-16].

Results

The kappa value for inter-observer reliability was 0.690 (0.654-0.739) (substantial agreement). The mean kappa value for intra-observer reliability was calculated 0.741 (0.476-1) (substantial agreement). Kappa values of intra-observer reliability for each observer are shown in Table 1. Intra-observer reliability was

Table 1. Kappa values of intra-observer reliability for each observer

Training Year	Observer Number	Kappa values (min-max)
2	1	0.672 (0.449-0.817)
2	2	0.827 (0.689-0.907)
2	3	1
2	4	0.476 (0.183-0.692)
2	5	1
2	6	0.654 (0.422-0.805)
3	7	0.776 (0.606-0.878)
3	8	0.637 (0.398-0.795)
4	9	0.734 (0.541-0.854)
4	10	0.512 (0.228-0.712)
4	11	1
5	12	0.635 (0.395-0.794)
5	13	1
5	14	0.515 (0.233-0.717)
5	15	0.544 (0.270-0.736)
Mean		0.741 (0.476-1)

highest in second-year residents (kappa value of second-year residents: 0.771, fourth year residents: 0.748, third year residents: 0.706, fifth year residents: 0.673). Results of the first and second reviews according to each Rockwood type are shown in Tables 2 and 3. It was observed that participants particularly had difficulty differentiating types 2-3 and types 3-5 (figures 1 and 2).

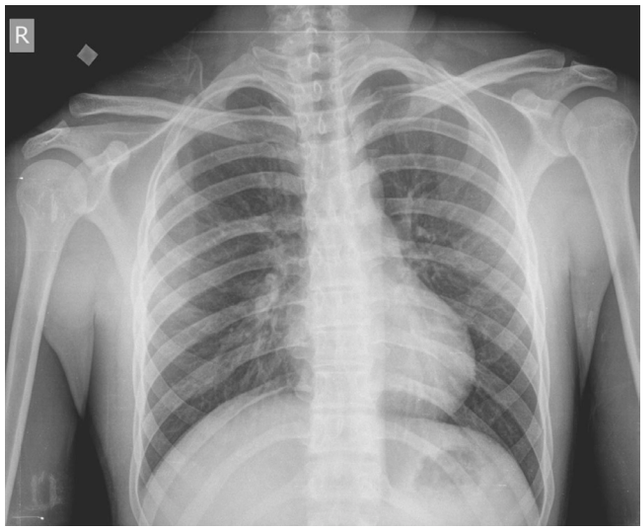

Figure 1. Difficulty in differentiating types 3 and 5 (case number 3)

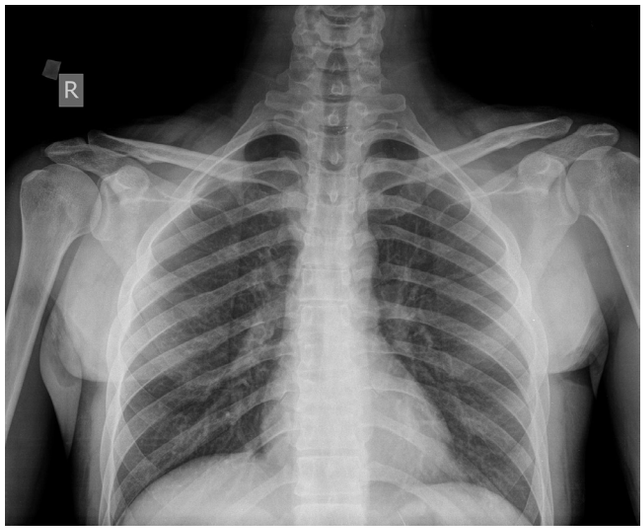

Figure 2. Difficulty in differentiating types 2 and 3 (case number 21)

Table 2. Results of the first review according to each Rockwood type

	Rockwood Types					
Patient Number	1 (n)	2 (n)	3 (n)	4 (n)	5 (n)	6 (n)
1		2	11	1	1	
2		1	13		1	
3			7	1	7	
4		4	10		1	
5	1	5	3	2	4	
6			10		5	
7	5	10				
8		3	9		3	
9			12		3	
10		6	7		2	
11		13	2			
12		3	1	11		
13	1	11	3			
14	1	9	5			
15	13	1	1			
16		4	10		1	
17			5	1	9	
18	4	8	2	1		
19	3	5	5	2		
20		6	6	3		
21		7	8			
22		7	8			
23		7	8			
24		5	5	3	2	
25		2	13			
26		12	3			
27		8	7			
28	3	12				
29				1	14	
30	4	11				
31	2	3	10			
32		12	2	1		
33		7	5	3		
34			5		10	
35			14	1		
36			9		6	
37	3	12				

Discussion

The ideal classification system should be simple, reliable, and repeatable and should be used as a guide for treatment and prognosis. In addition, such a system should provide a common and standard language for both clinicians and researchers. The diagnosis and treatment of AC joint injuries are compulsory for orthopedic surgeons. The Rockwood classification system is most frequently used for these types of injuries. In the literature, there are few studies assessing the intra- and inter-observer reliability of the Rockwood classification system [11-14]. Kraeutler et al. have researched this classification's reliability in types 3, 4, and 5 AC joint dislocations and found the intra- and inter-observer reliabilities as good [11]. Cho et al. reported the intra-observer reliability as moderate, and the inter-observer reliability as fair [14]. Ng et al. assessed the Rockwood, Tossy, and Allman classification systems on Zanca radiographs and reported the reliability as weak in all systems [13]. In our study, although intra- and inter-observer reliability of Rockwood classification system was generally found as good, it was noted that differentiating types 2 and 3, and types 3 and 5 is extremely difficult.

Differentiating type 3, 4, and 5 injuries is important in terms of treatment planning. While the type 5 dislocations are treated surgically, there is not a consensus about type 3 injuries, and these injuries are usually treated conservatively [4-9]. The differentiation between type 3 and type 5 in Rockwood's classic description has been made by comparing the distance between the upper surface of the coracoid and the inferior surface of the clavicle [3]. Orthopedic surgeons generally do not follow this principle, but more commonly assess this separation by

Table 3. Results of the second review according to each Rockwood type

	Rockwood Types					
Patient Number	1 (n)	2 (n)	3 (n)	4 (n)	5 (n)	6 (n)
1		3	11		1	
2		1	13		1	
3			10		5	
4		4	11			
5		5	4	2	4	
6		1	10		4	
7	5	9	1			
8		2	10	2	1	
9		1	11		3	
10		5	9		1	
11		10	4		1	
12		3	1	11		
13	3	11	1			
14		7	7		1	
15			14		1	
16		5	8		2	
17			9	1	5	
18	3	8	3	1		
19	4	10		1		
20	1	7	7			
21		7	8			
22		5	9	1		
23		8	7			
24		5	8		2	
25		3	11		1	
26	1	11	3			
27		9	6			
28	5	9	1			
29			1	1	13	
30	4	11				
31	2	5	8			
32		12	3			
33		8	3	3	1	
34			7	1	7	
35		1	14			
36			10		5	
37	1	14				

observing the relationship of the clavicle with the acromion in the shoulder antero-posterior radiography. We think that such assessment may lead to confusion in typology. Both in the study by Kraeutler et al. and in our study, a consensus has not been built regarding differentiating the classification of type 3 and type 5 injuries [11]. This complicates the treatment decision of the surgeon.

Observers first assessed the AC joint injuries by stress radiographs of the shoulder with the Rockwood classification system in the study of Schneider et al. Then, the coracoclavicular distances in the shoulder injured and the uninjured shoulder were digitally measured, and by comparing the distances, a coracoclavicular (CC) index was obtained. In the assessment using the classic Rockwood classification, they found intra- and inter-observer reliability to be good, but after supplementing this with thick index, they found the intra- and inter-observer reliability to be perfect. As a result, they have suggested that the measurement of CC should be added to the Rockwood classification in acute AC joint injuries [12].

In most studies, it has been shown that the standard anterior-posterior shoulder radiography may not be sufficient in the diagnosis of type 4 injuries [7, 8, 10]. It is not always possible to take axial radiography due to acute pain. Therefore, other diagnostic methods such as ultrasound, magnetic resonance imaging, or computerized tomography can be beneficial in diagnosis of these type injuries. In the study of Cho et al., 3-dimension computerized tomography has also been used in additional to conventional radiographs. The authors stated that the addition of tomography had not increased the classification system's reliability. Therefore, the authors concluded that the use of computerized tomography in the diagnosis of the AC joint injuries was unnecessary, considering the high radiation dose exposure and the cost [14]. However, this is a debatable issue and further studies are needed to research the effect of computerized tomography on this classification's reliability.

Schaefer et al. have claimed that it is possible to assess both coracoclavicular and acromioclavicular ligaments by magnetic resonance imaging (MRI). The authors also suggested that MRI may be used as a direct diagnostic method in AC joint injuries. In addition, the authors have stated that treatment method may change when MRI information was added to the radiographs [17].

There are some limitations of our study. The assessments were carried out based on shoulder anterior-posterior radiographs. Adding axial shoulder radiographs, computerized tomography, or MRI could affect the reliability of this classification system. Only orthopedic residents were included in the study so the effect of experience on the reliability of this classification system was not evaluated because more experienced surgeons were not included.

In conclusion, intra- and inter-observer reliability of the Rockwood classification system were found to be good although the experience levels of the participants were limited. However, there were difficulties in differentiating types 2-3 and 3-5 injuries. This confusion can cause either under-treatment or unnecessary over-treatment. In such conditions, additional imaging modalities such as computerized tomography or MRI can be beneficial.

Competing interests

The authors declare that they have no competing interests.

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